OBSTRUCTIVE PULMONARY CONDITIONS & 
ITS OCULAR IMPLICATIONS

By: Amiee Ho, O.D.
With contributions by Nada J. Lingel, O.D., M.S., F.A.A.O.
Pacific University College of Optometry

Course Description
- This course focuses on giving an introduction and review of common obstructive pulmonary diseases and conditions
- This course will also highlight some ocular consequences of these pulmonary diseases and conditions

Course Objective
- Briefly introduce and define obstructive pulmonary disease
- To review types of obstructive pulmonary diseases in detail: asthma, COPD, cystic fibrosis and obstructive sleep apnea
- To highlight how these pulmonary conditions relates to optometry and what ocular manifestations can result from these conditions

Outline
- Introduction
- Introduction of obstructive pulmonary disease
- Types of obstructive pulmonary disease:
  - 1. Chronic lower respiratory disease:
    - Asthma
    - COPD
      - Emphysema
      - Chronic bronchitis
    - Cystic fibrosis
  - 2. Upper respiratory tract:
    - Sleep Apnea

Optometric considerations
- Pulmonary disease can increase the risk of ocular disease
  - Dry Eye
  - Glaucoma
  - ARMD
  - Retinal vascular changes
  - Optic nerve head changes
- Pulmonary disease can contraindicate ocular medications

Optometric considerations
- Medications taken for pulmonary disease can cause ocular problems
• Medications taken for pulmonary disease can cause ocular problems
  • Optic atrophy
  • Glaucoma
  • Cataract
  • Blurred vision
  • Tear effects
  • Conjunctivitis

7 □ Lung disease
• Top 4 causes of death in adults
• Every year, > 200,000 Americans die of lung disease in US

8 □ Lung disease is common
• Lung disease is not only a killer, most lung disease is chronic
• > 35 million Americans are living with chronic lung disease

• Smoking is directly responsible for 90% of lung cancer and causes most cases of emphysema and chronic bronchitis

9 □ Symptoms of Lung Disease
  **TWO common symptoms of lung disease**
  1. Dyspnea
     • Shortness of breath (SOB)
     • Can be caused by lung or heart disease
  2. Chronic cough
     • Production of phlegm
     • Hemoptyisis: _heme_ (blood); _ptysis_ (to spit) – coughing blood

10 □ Atypical symptom of Lung Disease
• Chest pain is **not** a common symptom
• Lung tissue has no pain receptors
  • Pain is possible with:
    • Pleural disease
    • Pulmonary vascular disease
    • Musculoskeletal pain

11 □ Outline
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• **Types of obstructive pulmonary disease:**
  • 1. Chronic lower respiratory disease:
    • Asthma
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    • *Emphysema*
    • *Chronic bronchitis*
Introduction to Obstructive pulmonary disease

**Definition:** Limitation of airflow especially on exhalation (passive process)

- Makes breathing harder
- Can be caused by:
  1. Change in lumen size
  2. Thickening of airway wall
  3. Changes in supporting structure surrounding the airway

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Asthma

- Common syndrome found in 1 in 12
- Genetic predisposition to type I hypersensitivity
- There are different asthma phenotypes
  - Some have ↑ IgE, some ↓ IgE
  - Treatment is all the same currently
- More likely to have asthma:
  - Children: can grow out of it
  - Females: smaller pipes
  - African American: genetically more susceptible

Asthma

- Characterized by exacerbations and remissions
- Initiating factors include:
  - Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle,
• Initiating factors include:
  • Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle, obesity, lack of sleep, alcohol, (exercise)

Poor Control:
• 93% of patients with inhalers missed at least one important step for correct use
• For example: exhaling fully or shaking inhaler before use
• 1 in 5 children with asthma go to ER for asthma each year

16 Signs and symptoms
• Intermittent (patients appear normal between attacks)
• Vary due to range in severity

  Signs/Symptoms include:
  • Chronic cough
  • Wheezing (if severe, wheezing may not be present)
  • Chronic episodic dyspnea (SOB)
  • Sympathetic discharge (perspiration/flushing of skin)
  • Tightness in chest
  • Tachypnea
  • Severe cases can have cyanosis of nail beds, confusion, agitation, nasal flaring, difficulty talking, no breath sounds

17 Asthma Therapy
Goals:
• Relieve symptoms
• Prevent recurrences of attacks

Therapies:
• Control triggers including smoking cessation
• Exercise and breathing exercises
• Bronchodilators: Adrenergic and Anticholinergics
• Anti-inflammatories
  • Steroid anti-inflammatories
  • Leukotriene inhibitors
  • Mast cell stabilizers
  • Monoclonal antibodies against IgE
  • Vitamin D?
• Thermoplasty – using radiowaves to change shape of airways

18 Glucocorticoids
Most common adverse effects:
• Osteoporosis
• Impaired wound healing
• Increased risk of infection
• Hypertension
• Decreased growth in children (oral >> than inhaled)
• Hypertension
• Decreased growth in children (oral >> than inhaled)

2

• Edema
• Ulcers
• Psychoses
• Cushing-like syndrome
• Oral candidiasis (Thrush) – use spacer to ↓ risk
• Glaucoma
• Cataracts
• ↑ risk of DM

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FDA guidelines:

Use inhaled glucocorticoids with caution in patients with:

• Parasitic infection (ex: histoplasmosis)
• Active or inactive TB
• Ocular herpes simplex
• Increased IOP

**use caution, but not absolute contraindication!

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Chronic Obstructive Pulmonary Disease (COPD)

Includes two common diseases:

• Emphysema
• Chronic bronchitis
• Slowly, progressive airway obstruction
• Disease does NOT go away!
• Takes years to become clinically apparent
• 1st symptom: SOB on exertion
• People tend to subconsciously avoid exertion tasks to mask symptoms

22
• COPD
  - About 15 million US adults have COPD diagnosis
  - Probably more, just undiagnosed
  - Smoking is the #1 cause
    - 6 – 10% of adult pop but up to 50% of smokers
  - Lifetime risk is now estimated at ¼
  - COPD kills more than 120,000 Americans each year
    - 1 death every 4 minutes

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24 Emphysema
  • ≈ 4 million diagnosed patients in the U.S.
  • Abnormal enlargement of the air spaces due to destruction of alveolar wall
  • Repeated and prolonged inflammation causes release of proteolytic enzymes that digests alveolar septal walls
  • Most common cause: cigarette smoking
    • Tobacco allows destructive enzymes to work over time and destroy alveoli walls

25 Typical emphysema patient
  "Pink puffer"
  • Thin (working to breath all the time)
  • Average person: 4-5% calories breathing
  • Pink puffer: ~30% calories breathing
  • Pursed lips respiration
  • Tripoding
  • SOB and tachypnea (breath quickly)

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27 **Chronic bronchitis**
• ≈ 10 million diagnosed patients in the U.S.
• Chronic bronchitis is more common than emphysema: ~3/4 of patients with COPD
• Leading cause is cigarette smoking, also air pollution and infections
  • Definition: Persistent, productive cough on most days for at least 3 consecutive months in 2 consecutive years
  • This defines CHRONIC
  • Anyone with a cold has had chronchitis – but those are acute symptoms

28 **Chronic bronchitis (Smoker's cough)**
• Inflammation of the airways* with hypertrophy of large airway mucous glands and hypersecretion of mucus*
  • Airway size is **compromised** and **obstructed**

Clinical manifestations:
• Wheezing - Tremendous mucus production blocking airways
• Crackles - Caused by edema
• Tachycardia is common but not universal
• Periphery not getting enough O2 → lungs will breath faster and heart will pump faster to get blood out
• Polycythemia - 1 RBC to carry O2 → 1 risk of clotting

29 **Typical chronic bronchitis patient**
“Blue bloaters”
• Stereotypical chronic bronchitis patient
• Chronic cough and expectoration
• Obese, edematous due to right sided heart failure
• Heart has to push against closed capillaries when there is poor oxygenation of the lungs
• Increased anterio-posterior chest diameter – using accessory muscles
• Cyanotic
• CO₂ narcosis can cause decreased memory and info processing ability

30 **Chronic bronchitis**
Lack of O₂ causes a lot of ocular problems!

Associated with:
• Decreased VA especially at night
Associated with:
• Decreased VA especially at night
• Decreased color vision
• Transient visual obscurations (different from TIA)
• 7% had swollen optic nerve heads
• 82% had decreased retinal function as determined by abnormal VEP
• Increased risk with increased PCO$_2$ and decreased pH in blood

31 Treatment for chronic bronchitis and emphysema
No curative therapies but treatment may slow progression
• **Goal:** control of symptoms and avoiding harmful environments
  • Smoking cessation including vaping
  • Many still smoke with diagnosis
  • Pharmaceutical treatment very similar to treatment for asthma

32 Pharmaceutical Tx for chronic bronchitis and emphysema
Bronchodilators
• Short acting or long acting Beta-2 agonists
• Anticholinergics

Anti-inflammatory drugs
• Glucocorticoids
  • Most useful during exacerbations
  • May decrease number of exacerbations

Combination medications
• Steroid & long acting beta agonists
• Long acting beta agonist/long acting muscarinic antagonist

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34 Cystic fibrosis (CF)
• Most common lethal genetic disease that affects Caucasians
• 1 in 3700 live births in North America
• Autosomal recessive trait:
  • $\approx$1 in 30 Caucasians are carriers
• Multi-system disease associated with abnormal chloride transport of epithelial cells
• Either protein is in wrong place or it doesn’t function well
• Multi-system disease associated with abnormal chloride transport of epithelial cells
• Either protein is in wrong place or it doesn't function well
• Increases chloride and sodium content in sweat
• "Sweat test": mother's kissing salty child

35 □ Cystic fibrosis

Pulmonary involvement:
• Infection with normal floral bacteria
• Followed by infection with other bacteria
• Cilia not working well, can't cough it out!
• Persistent infection and inflammation cause damage to airway walls and obliteration of small airways*
• Most patients die of pulmonary failure secondary to infection
• Two CF patients cannot be in the same room!

36 □ Many other organ systems are involved in CF

Any organ system with a duct will likely be affected!
• ↑ thickness of secretions causes blockage
• Poor digestion of fats
• Malabsorption of proteins and carbohydrates
• Infertility (fertility ducts blocked)
• Cirrhosis of liver (liver ducts blocked)
• Increased incidence of sleep apnea (sinuses blocked)

37 □ Ocular involvement in CF

Abnormal chloride transfer in the eye
• Aqueous deficient dry eye with epithelial staining
• Reduced endothelial cell density
• Increased corneal thickness (edema)
• Posterior sub capsular cataract
• Reduced contrast sensitivity (Cl problems in retina)
• Diabetic retinopathy (diabetes more common → pancreas issue)
• Nutritional effects: decreased macular pigmentation; Xerophthalmia

38 □ Tx of cystic fibrosis

No cure, try to improve length and quality of life!

Airway clearance techniques
• Goal: remove mucus build up to prevent infection
• Medicinal method:
  • Can use dornase alpha (Pulmozyme)
  • Makes sputum less viscous and easier to clear
  • Can cause condition similar to bacterial conjunctivitis

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40 Sleep apnea
  • Apnea: complete cessation of respiration 10 seconds
  • 2 forms of sleep apnea
    • 1. Central:
      • Not an obstructive disease
      • Cheyne-Stokes respiration: dysfunction in brain respiratory control centers
      • Poor feedback loop: low O2 gets to brain → breathe MORE → high O2 → breathe less(stops breathing) → low O2……
      • Often due to heart failure (slow response due to poor blood flow)
    • 2. Obstructive: mechanical (MOST common)

41 Obstructive Sleep Apnea (OSA)
  • Most common sleep disorder
  • Prevalence depends on how defined
  • Most agree that 3-7% of adults have mod to severe sleep apnea
  • Found in up to 1/4 of males over 20 years of age if include mild forms
  • Women less commonly affected (tend to be post menopausal)
  • Often undiagnosed (80%)
  • Can also occur in children (ex: CF or down syndrome)

42 Obstructive Sleep Apnea (OSA)
  Symptoms
  • Loud snoring (patient unaware)
  • Chronically disturbed sleep (patient unaware)
  • Excessive daytime sleepiness
  • Irritability, depression, and personality changes
  • Morning headaches
  • Tired upon awakening
  • Cognitive impairment (MRI scans on mammillary bodies)

43 OSA pathophysiology
  • OSA is due to complete collapse of upper airway* in sleep
  • Upper airway: soft palate, uvula, the jaw
  • As patient enters deep sleep, upper airway closes
  • Thrashes, snorts, partially awakens and reopens airway with a gasp
  • Can occur hundreds of time per hour
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44 OSA contributing factors
These factors ONLY ↑ risk of having OSA:
• Most patients are obese and have "thick" necks
• Fat around neck helps occlude airways
• May have small or receding jaw
• May have increased size of soft palate and tongue
• Often a history of heavy drinking
• Alcohol relaxes muscles and less likely to wake from sleep
• History of asthma

45 Medical conditions associated with OSA
• HTN in 30 to 50% with OSA; often difficult to control
• Treating HTN drops BP by 3-5mmHg ( = to a med)
• Obesity
• Multiple sclerosis (loss of muscle tone)
• Diabetes (3X) (1.7X even if control for obesity)
• Increased risk of retinopathy, especially macular edema (lack of O2)
• Cardiovascular disease (lack of O2)
• Ischemic heart disease, MI and angina (4-7X)
• Nocturnal cardiac arrhythmias (2– 4X)
• Stroke (3-8X)
• Heart failure

46 Obstructive sleep apnea increases the incidence of some conditions
**Likely due to decrease in O2 supply!
• Alzheimer disease/ Brain atrophy/ Cognitive decline
• Emotional problems
• Impotence
• Osteoporosis (2X)
• Glaucoma (7-8% vs 2%) especially normal tension glc
• Anterior ischemic optic neuropathy
• Motor vehicle accidents (MVA) (2 – 7X): falling asleep while driving
• With CPAP use: Corneal dryness, Corneal ulcers, Bacterial ocular infections

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Amiee Ho, O.D.
Assistant Professor
Pacific University College of Optometry
amieeho@pacificu.edu